

Renewable Energy Opportunities in the Midwest

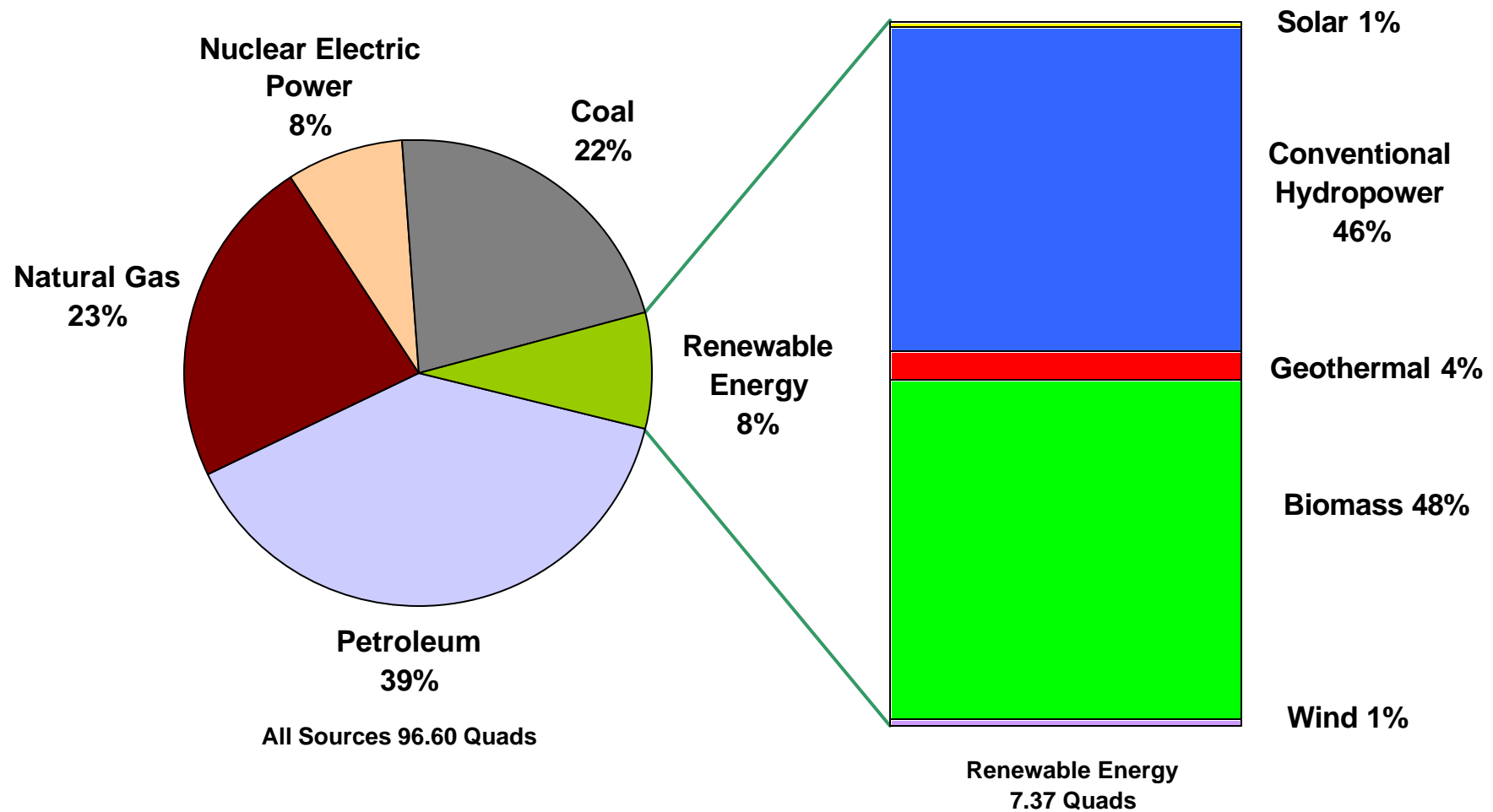
Gary Nowakowski
U.S. Department of Energy
Chicago Regional Office
Gary.nowakowski@ee.doe.gov
312-886-8575

Renewable Energy: Benefits to All

- Economic development
- Cleaner environment
- Improved national security
- Less reliance on imported fuels

“73 percent of Americans believe the U.S. should develop new energy sources to diminish its dependence On Mideast oil supplies” – Newsweek Poll, Nov, 2001

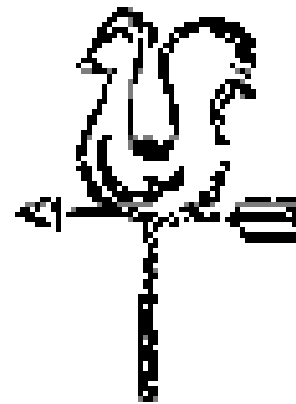
U.S. Primary Energy Consumption, 1999



Source: EIA Annual Energy Review 1999

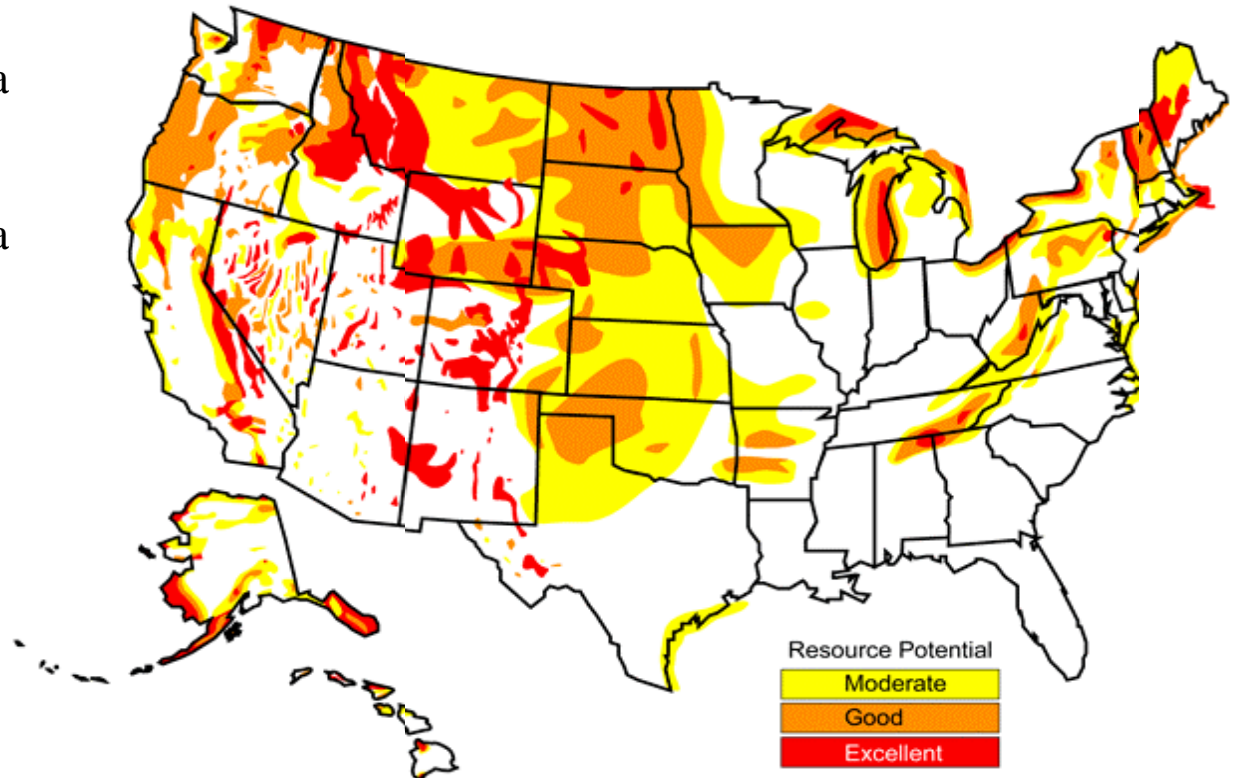


Wind



Wind Potential

Rank	State
1	North Dakota
2	Texas
3	Kansas
4	South Dakota
5	Montana
6	Nebraska
7	Wyoming
8	Oklahoma
9	Minnesota
10	Iowa
11	Colorado
12	New Mexico
13	Idaho
14	Michigan
15	New York
16	Illinois
17	California
18	Wisconsin
19	Maine
20	Missouri

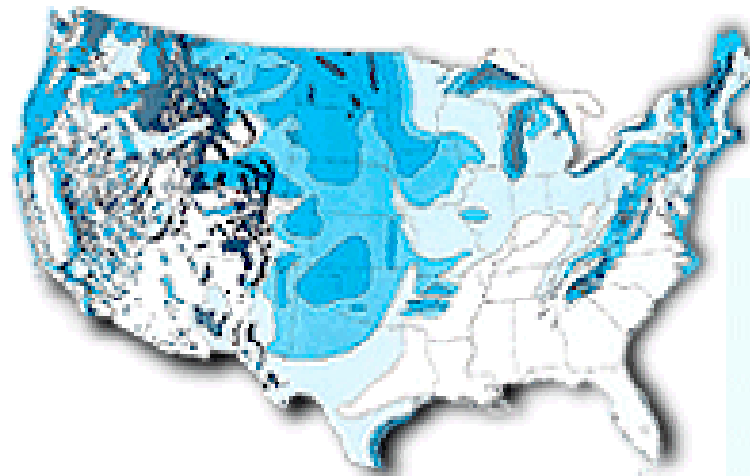


World Class Wind Potential

Germany's Potential: 100 GW

North Dakota's Potential: 250 GW

Source: AWEA



Note that these general maps may not show all of the available resources. Some terrain and meteorological effects can result in excellent localized wind resources in areas not shown here.



Missouri annual average wind power

WIND POWER CLASS	50m (164 ft)		
	WIND POWER W/m ²	SPEED	
		m / s	mph
1	0	0	0
2	200	5.6	12.5
3	300	6.4	14.3
4	400	7.0	15.7
5	500	7.5	16.8
6	600	8.0	17.9
7	800	8.8	19.7
	2000	11.9	26.6

RIDGE CREST ESTIMATES (LOCAL RELIEF > 1000 FT)

Cost of Energy Trend

1979: 40 cents/kWh

**2000:
4 - 6 cents/kWh**

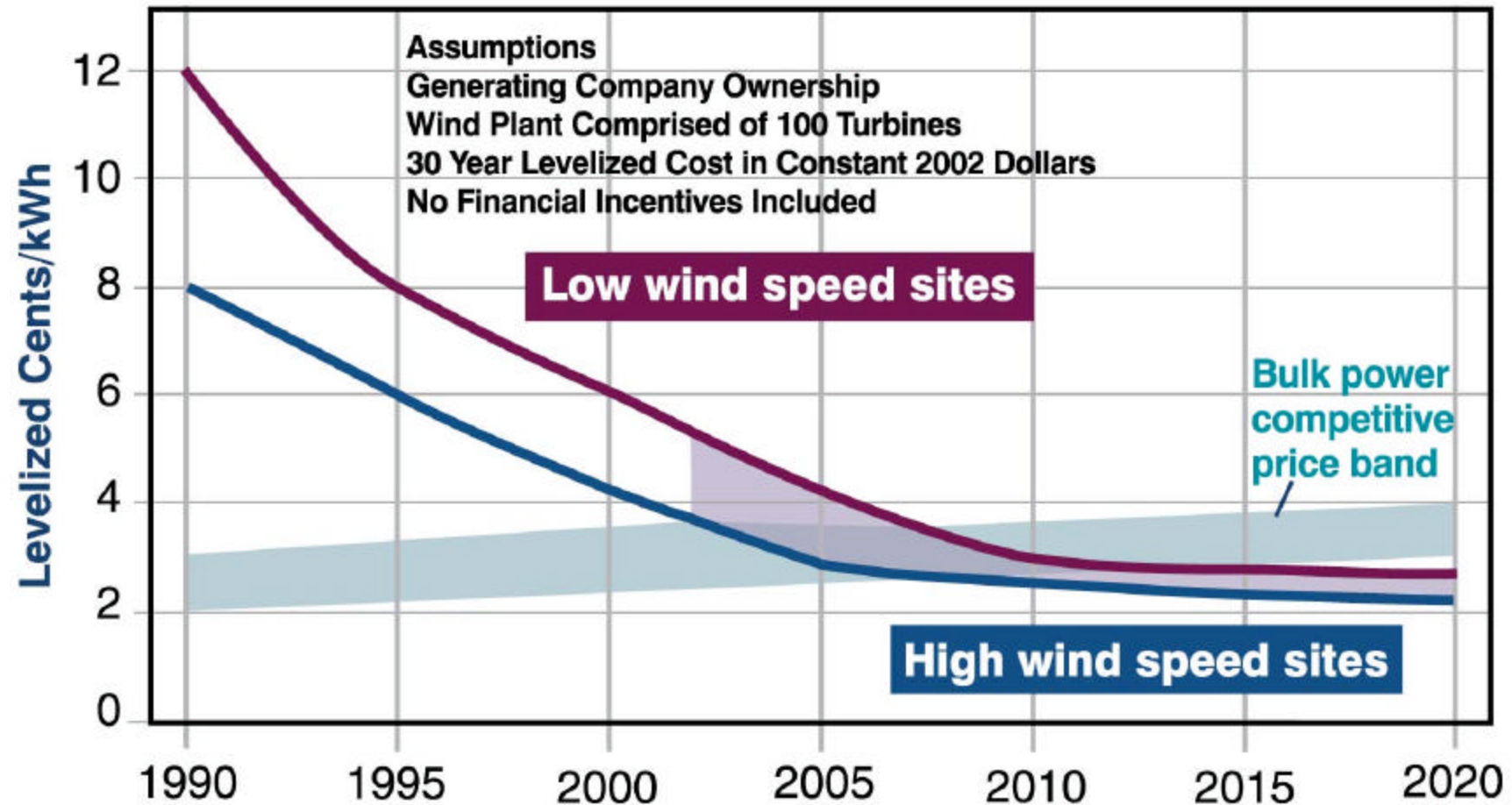
- *Increased Turbine Size*
- *R&D Advances*
- *Manufacturing Improvements*



NSP 107 MW Lake Benton wind farm
4 cents/kWh (unsubsidized)

**2004:
3 - 5 cents/kWh**

The Falling Cost of Wind Power



A General Electric 1.5 MW Wind Turbine



A General Electric 1.5 MW Wind Turbine



*1.5 MW Wind Turbine:
Enough power to supply
Approximately 500 homes*

A 750 kW NEG Micon Wind Turbine



Blade Testing at National Wind Technology Center

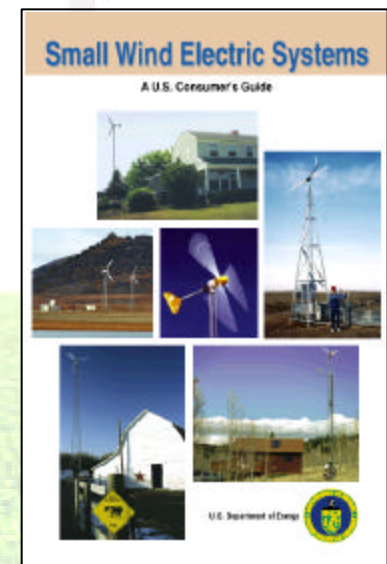


U.S. DOE's Wind Program Focus:

- *Low wind speed turbine development*
- *Small wind turbine development*



- State/Regional Wind Workshops
- Anemometer Loan Programs
- Resource Maps
- Tribal Power
- Outreach Materials

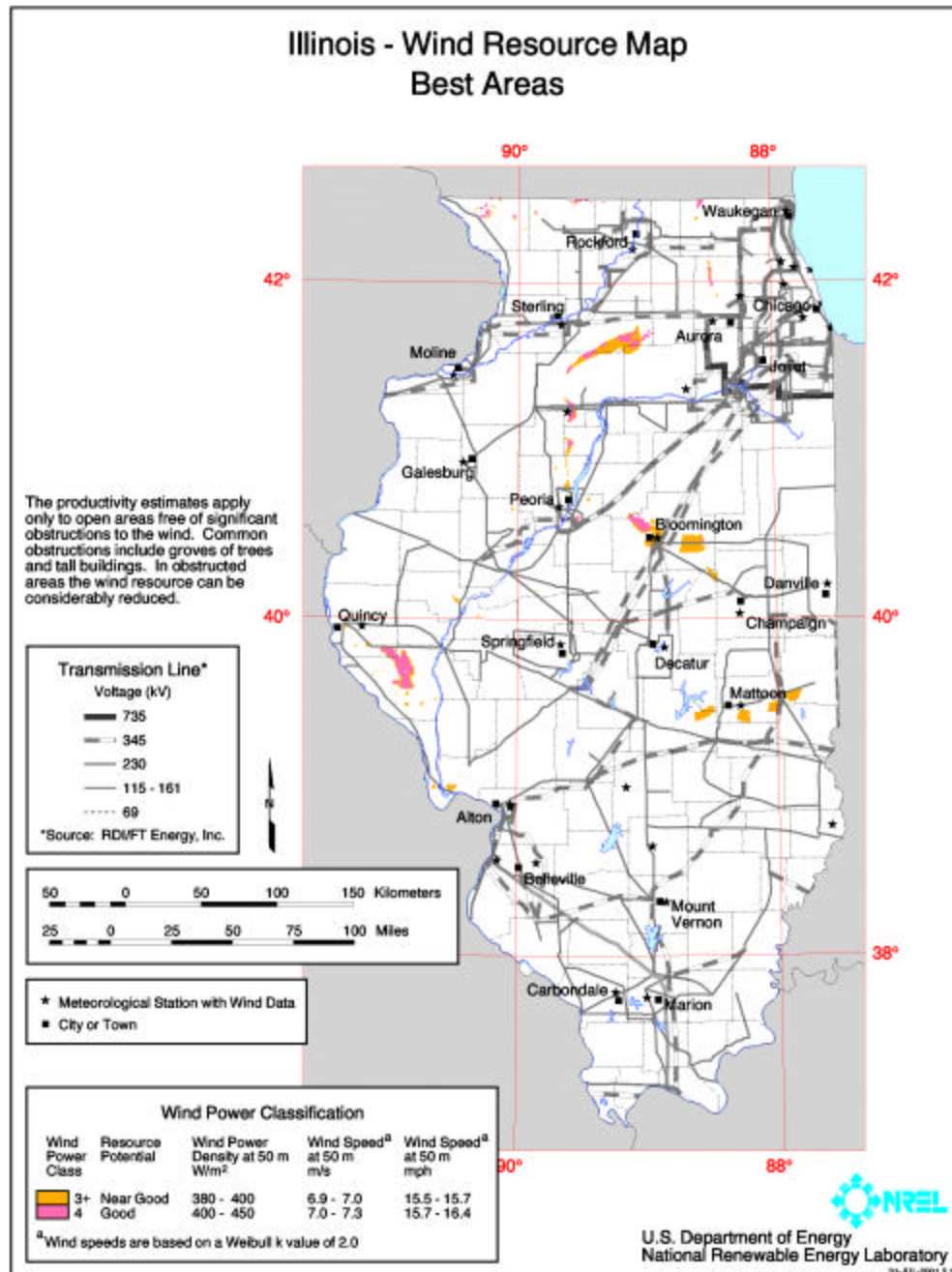




Goals

- Wind Resources to provide 5% of nations electricity by 2020
- \$60 billion in capital investment in rural America over 20 years
- \$1.2 billion in new income for farmers, Native Americans, and rural landowners over 20 years
- 80,000 permanent jobs by 2020
- 35 million tons of carbon displaced in 2020



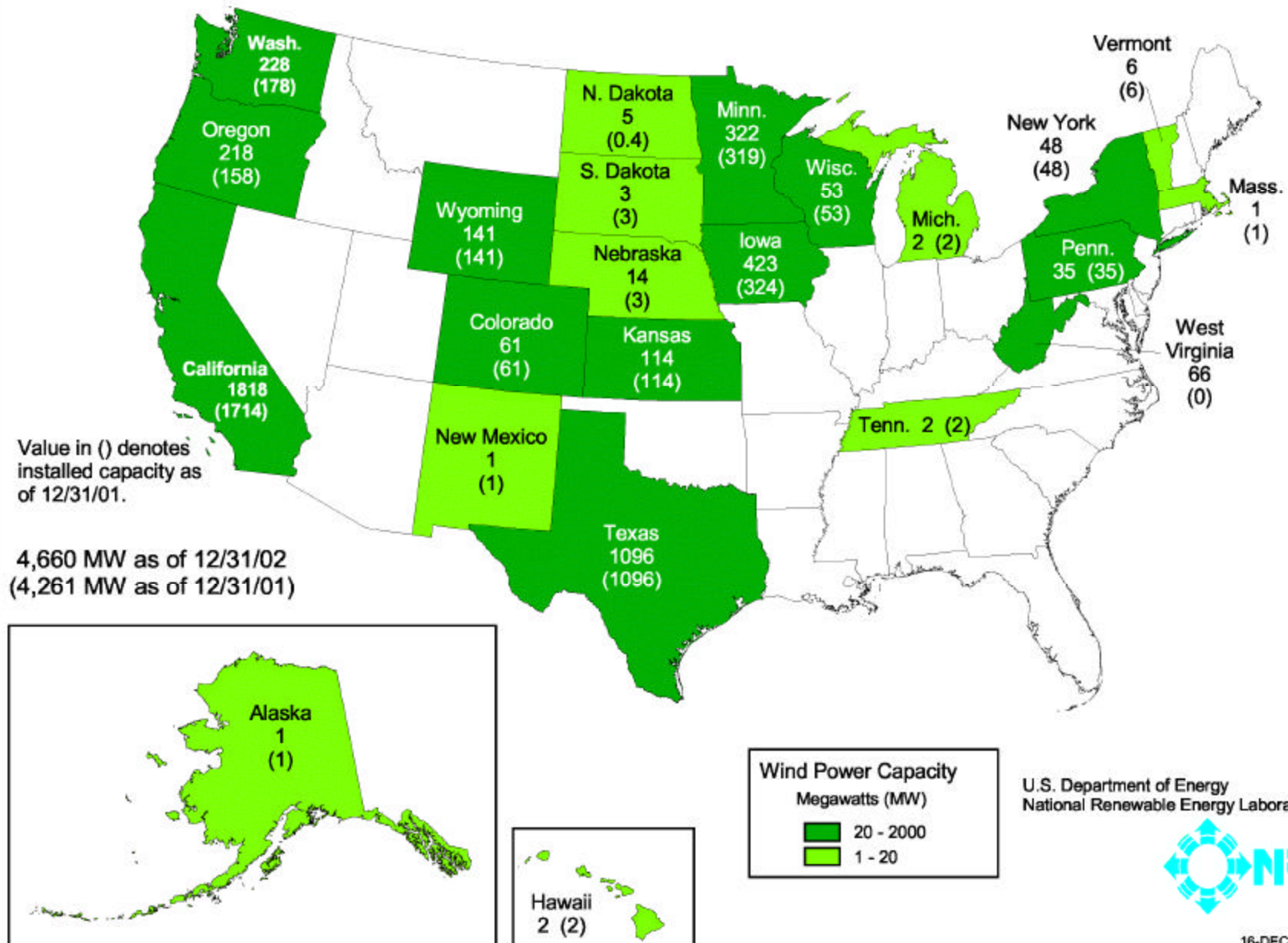


Recent Illinois Wind Resource Map

- Shows best areas for utility-scale development (Class 3+ and Class 4 areas)
- 3,000 to 9,000 MW of potential installed capacity for Class 3+ and Class 4

www.eren.doe.gov/windpoweringamerica/images/illinois_high800.jpg

Current Installed Wind Power Capacity (MW)



Economic Development Opportunities

- Land Lease Payments: 2-3% of gross revenue \$3000-5000/MW/year
- 1-2 jobs/MW during construction
- Local construction and service industry: concrete, towers usually done locally
- About 1 permanent O&M jobs per 10 MW
- Local property tax revenue: 100 MW brings in on the order of \$1 million/yr
- Manufacturing and Assembly plants expanding in U.S. (GE Power Systems in CA, NEG Micon in IL, LM Glasfiber in ND)

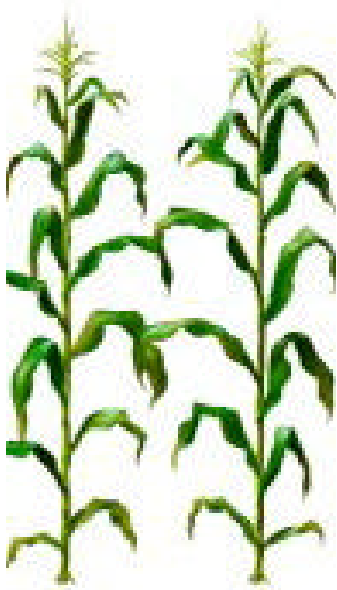
Biomass



Missouri– A Leader in Agriculture

- Top Ten States in Crop Production
 - Hay, sorghum, rice, soybeans, corn, cotton and Watermelon
- Top Ten States in Livestock
 - Beef cow operations, Milk cow operations, Turkeys, Hogs, Pigs and Ice Cream (low fat)

Ethanol Production

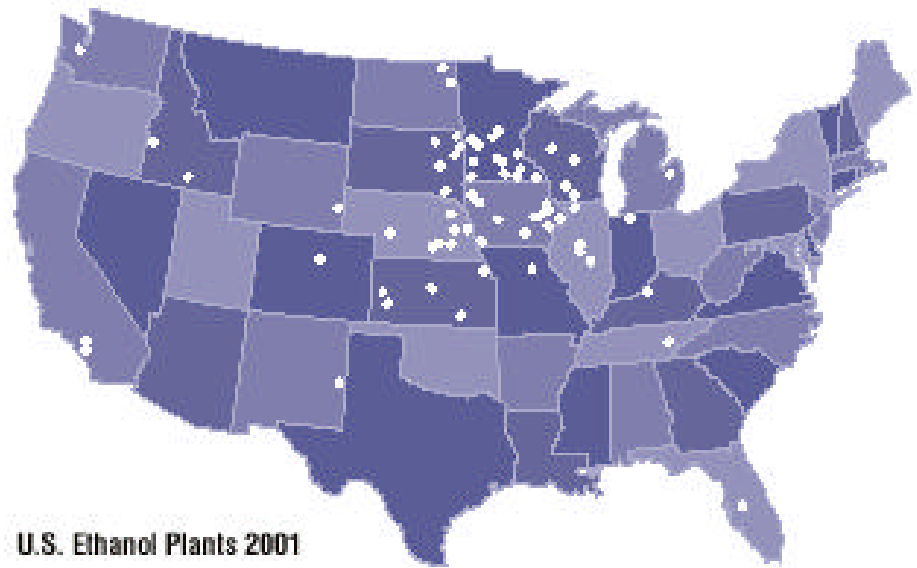


***80% of all ethanol
Is produced in the “Corn
Belt” region***

Missouri Ethanol Cooperatives

Northeast Missouri Grain, LLC

Golden Triangle Energy Cooperative, Inc.



U.S. Ethanol Plants 2001

***7% of all corn grown is used to produce ethanol, but only about ethanol
Represents only 1 - 2% of transportation fuel***

Ref: U.S. DOE-EIA, USDA

Direct & Indirect Benefits of Ethanol

- Current Missouri Ethanol Production (41 mmgy)
 - 1,815 jobs
 - \$172.8 Million of total economic output
- Current & Proposed Missouri Ethanol Production (5 plants)
 - 8,890 jobs
 - \$845 Million of total economic output

Ref: Missouri Corn Growers Association – 2001

southern states energy board

SERBEP

Southeastern Regional Biomass Energy Program



U.S. DOE's Biomass Program Focus:

- *Biorefineries*
- *Ethanol production from agricultural residues*
- *Biomass gasification*

Biorefinery Concept



USES

Fuels:

Ethanol
Renewable Diesel

Electricity

Heat

Chemicals

- Plastics
- Solvents
- Pharmaceuticals
- Chemical Intermediates
- Phenolics
- Adhesives
- Furfural
- Fatty acids
- Acetic Acid
- Carbon black
- Paints
- Dyes, Pigments, and Ink
- Detergents
- Etc.

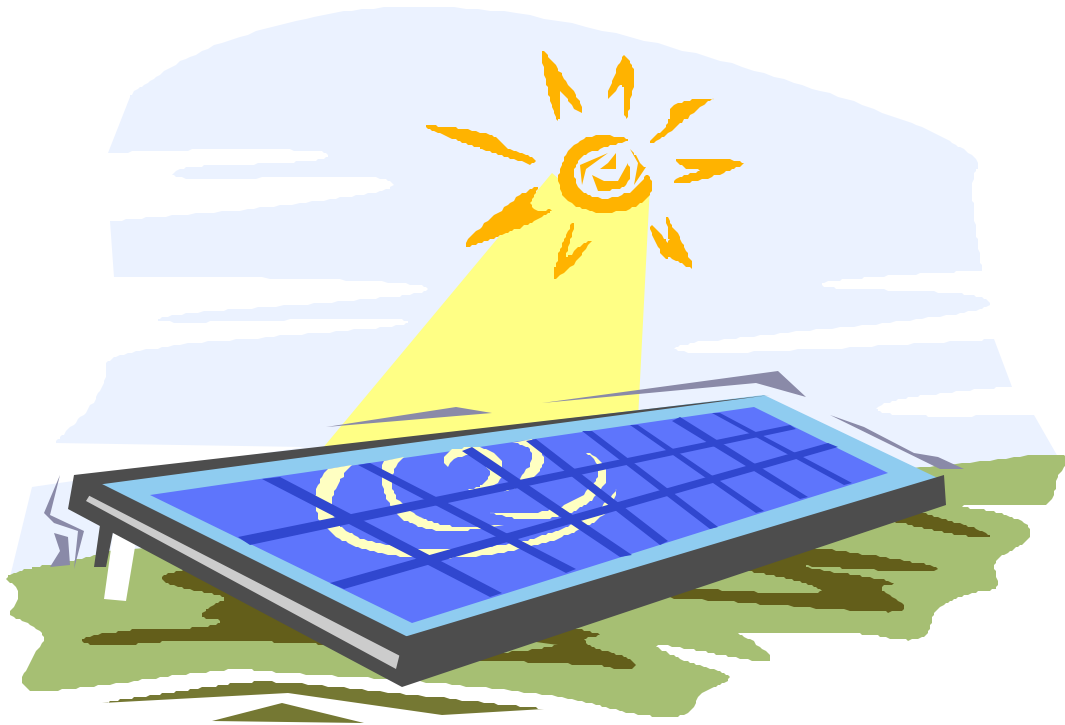
Biomass Feedstock

- Trees
- Grasses
- Agricultural Crops
- Agricultural Residues
- Animal Wastes
- Municipal Solid Waste

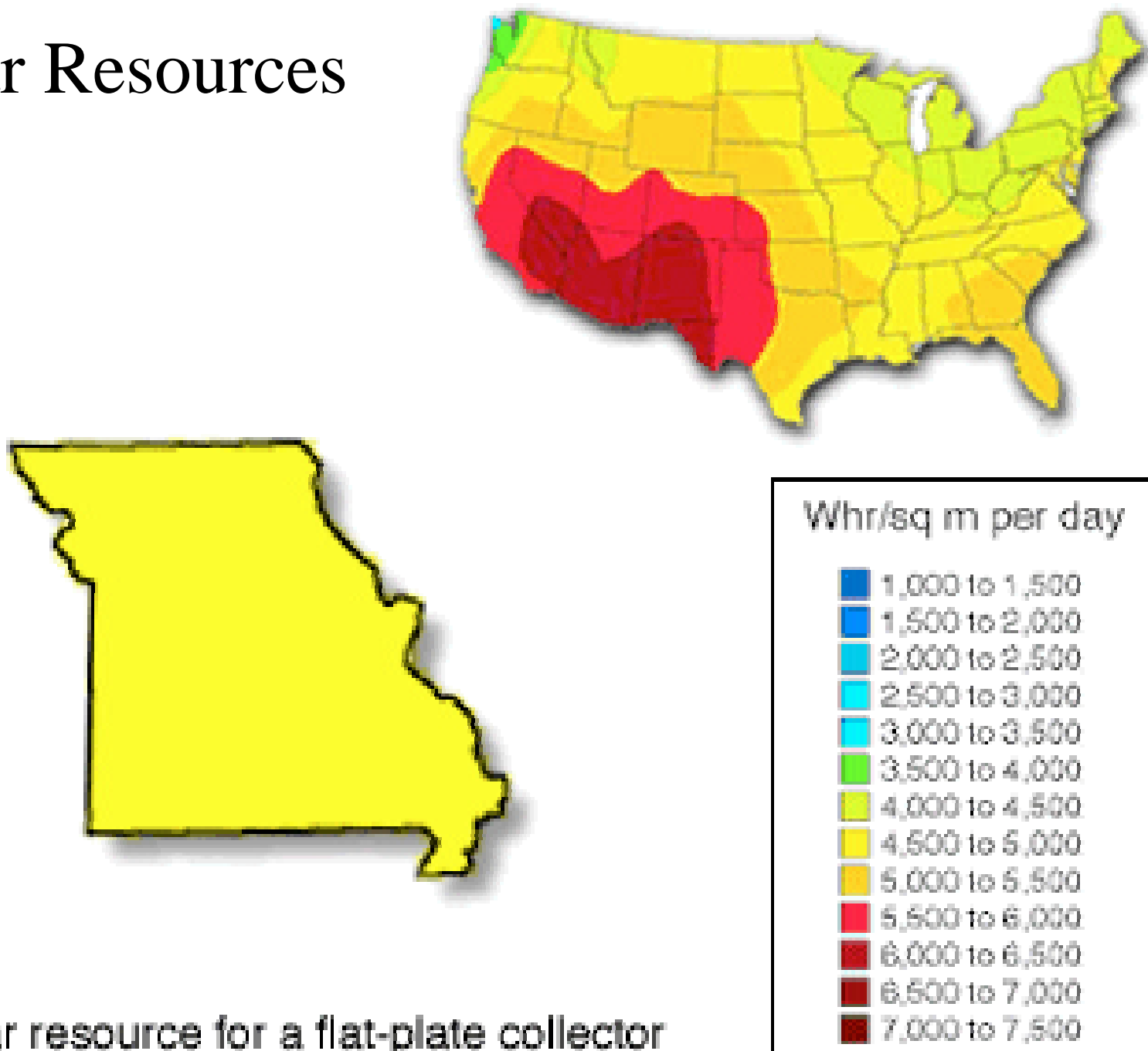
Conversion Processes

- Enzymatic Fermentation
- Gas/liquid Fermentation
- Acid Hydrolysis/Fermentation
- Gasification
- Combustion
- Co-firing

Solar



Solar Resources



Solar resource for a flat-plate collector

The Falling Cost of Solar Power

1980:
\$1.00/kWh



2000:
~ 20 cents/kWh



2005:
~ 10 cents/kWh



DOE's Solar Program

- Focus Areas
 - Fundamental Research
 - Improve cell material and efficiency
 - Materials and Devices
 - Thin Film R&D
 - Crystalline-Silicon
 - Advanced Manufacturing R&D
 - Technology Development
 - Reliability
 - Building integrated PV R&D
 - Outreach and Analysis
 - Solar Water and Space Heating

The long term goal is to:

-- generate power for \$0.06/kW-hr by 2020

-- reduce the cost to generate hot water from \$0.08 to \$0.04/kW-hr by 2005



Midwest Partners:

State of Iowa

State of Wisconsin

City of Chicago

Great Lakes Renewable Energy Association (Michigan)

Foundation for Environmental Education (Ohio)

Midwest MSRI partners have pledged the installation of 25,000 systems & will surpass 1 MW of installed capacity this year

U.S. DOE Student Competition Solar Decathlon



**Crowder
College**

6th Place

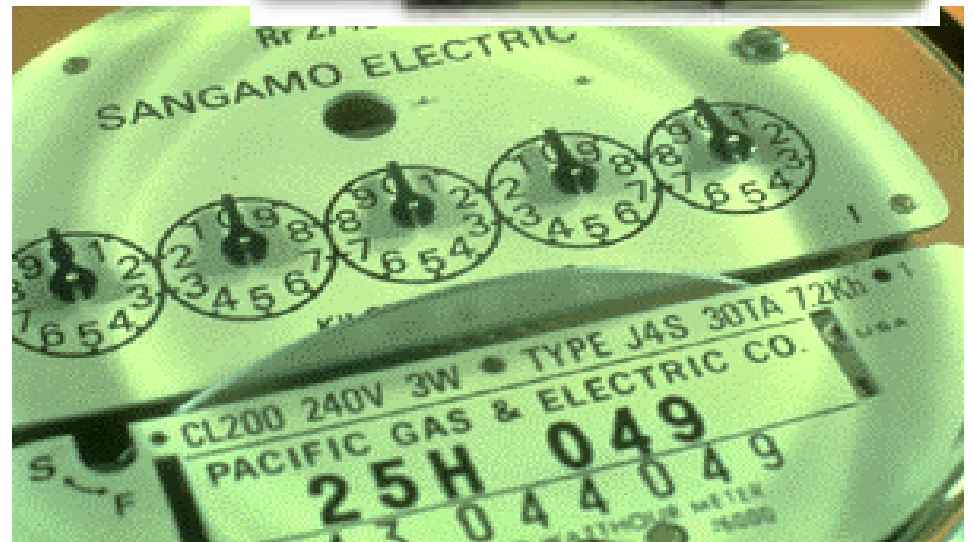


9th Place



Elements of Growth

- Federal and State Policies
 - Renewable Portfolio Standards (RPS)
 - System Benefit Charges (SBC)
 - Production Tax Credit
 - R&D
- Utilities
 - Green Power Products





The Future is Bright for Renewable Energy Development in Missouri